

REMARKS

In the official action dated July 26, 2005, claim 1 was rejected as unpatentable over Modak (US 6,537,913) in view of Liu (US 6,211,085), claims 2-4 were rejected as unpatentable over Modak in view of Liu and Huang et al. (US 5,527,736), claim 5 was rejected as unpatentable over Modak in view of Liu, Huang, and Gupta (US 6,114,243), and claim 6 was rejected in view of Modak in view of Liu, Huang, Gupta, and Wang (US 6,184,128). In view of the forgoing amendments and the following remarks, reconsideration of this application is respectfully requested.

As an initial matter, claim 1 has been amended to recite removing a portion of the Cu outside of the trench portion by a Cu chemical mechanical polishing (CMP) process. This method is disclosed in paragraph [0019] of the specification. Claims 5-6 have been cancelled. New claims 7-11 have been added. The limitations recited by new claims 7-11 are disclosed in paragraphs [0016] and [0019] of the specification. Therefore, the applicant respectfully submits that no new matter has been added.

Independent claim 1 recites a method for forming a contact of a semiconductor device having a Cu line using a dual damascene process. The method includes forming a tungsten plug that occupies a lower part of a dual damascene pattern and a copper line that occupies an upper part of the dual damascene structure.

Modak discloses a method for making a semiconductor device that includes copper interconnect pads having aluminum caps. Modak discloses that a lower part of a dual damascene structure is filled with copper and an upper part of the dual damascene structure is filled with aluminum. Further, Modak discloses, "copper layer 105 must be recessed

sufficiently deep into dielectric layer 101 to ensure that a subsequently deposited aluminum layer will maintain a sufficient thickness to serve as an aluminum capping layer that protects the underlying copper from oxidation, even after the aluminum layer has been polished and cleaned.” (Col. 3, line 62 to Col. 4, line 1) Modak does not disclose or suggest that copper could or should be used for an upper metal layer.

The examiner admits that, “Modak lacks the “first metal layer 105” being tungsten and the “second metal layer 108” being copper.” (Office action of July 26, 2005, Page 3 last paragraph) The examiner seeks to cure the deficiency of Modak by citing Liu. The examiner asserts that Liu discloses that, “a dual-damascene-contact structure may be formed by specifically incorporating tungsten … and copper … wherein tungsten is used in a contact hole portion … and copper is used to fill a trench portion of the dual-damascene-contact structure.” (Office action of July 26, 2005, Page 4 first paragraph) The examiner contends that it would have been obvious to modify Modak by utilizing tungsten and copper.

MPEP § 2143.01 states, “The fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of combination. *In re Mills*, 916 F.2d 680, 16 USPQ2d 1430 (Fed. Cir. 1990).”

The applicant respectfully submits that the prior art of reference does not suggest the desirability of modifying Modak to use tungsten and copper. In particular, it would not have been obvious to modify Modak to replace the aluminum capping layer 109 with copper. Modak teaches, “When copper is used to make … an interconnect pad, the copper may oxidize if exposed. Consequently, to make a copper containing interconnect pad, an aluminum cap may be formed on the copper to protect it from oxidation. The wirebond is

then made to the aluminum cap.” (Col. 1, lines 15-20) In light of this disclosure, one of ordinary skill in the art would not have been motivated to modify Modak to include an upper layer made of copper. Rather, Modak specifically teaches away from the use of copper for the upper layer.

The Office action asserts that “[t]he only distinction between Modak and the current invention seems to reside in the specific combination of materials recited in the current claims; however, the combination of materials disclosed in the current invention is held obvious.” (Page 8, ¶ 2) The examiner’s comment implies that the selection of materials in the present invention is an insignificant modification of the prior art. On the contrary, the selection of materials in semiconductor devices is crucial to the function of such devices. As in the chemical arts, selection of materials in the art of semiconductor manufacture is not trivial as suggested by the examiner. In particular, Modak discloses that aluminum has been specifically selected for the upper metal layer to inhibit oxidation of the underlying copper plug, which enables the formation of strong wirebonds. (Col. 4, lines 48-41) Accordingly, the use of copper as an upper metal layer is directly contradictory to the desired function and/or purpose of the semiconductor structure taught by Modak.

Further, the applicant submits that a combination of a method of preparing copper interconnect lines (Liu) and a method of making a semiconductor device with aluminum capped copper interconnect pads (Modak) is not proper because the disclosed processes are different from each other. When making obviousness rejections, the references used must be viewed without the benefit of impermissible hindsight vision afforded by the claimed invention. *See Hodosh v. Block Drug Co., Inc*, 229 U.S.P.Q. 182, 187 n.5 (Fed. Cir. 1986).

“Impermissible hindsight must be avoided and the legal conclusion [of obviousness] must be reached on the basis of the facts gleaned from the prior art.” M.P.E.P. § 2142. The prior art of record is devoid of any suggestion that copper should be substituted for aluminum in the upper metal layer in Modak. The mere use of copper in the upper metal layer of Liu would not suggest the desirability of substituting copper for aluminum. Rather, as previously noted, Modak teaches that copper is an undesirable material for an upper metal layer because it will oxidize; resulting in reduced strength for a wirebond.

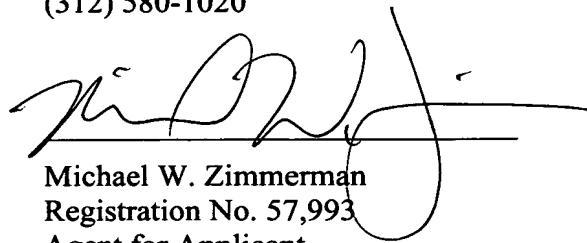
In light of fact that Modak teaches away from the use of copper in the upper layer of the dual-damascene structure, it would not have been obvious to persons of ordinary skill in the art to modify Modak by replacing the aluminum capping layer 109 with copper. Thus, even if Liu discloses that an upper layer of a dual-damascene structure may be copper, it would not be obvious to combine Modak and Liu in light of the teachings of Modak. Accordingly, for at least the forgoing reasons, it is respectfully submitted that claim 1 is not obvious in view of the cited art. Further, even if Huang teaches that an upper layer of a dual-damascene structure may be copper, Huang cannot cure the forgoing deficiency. Thus, for at least the forgoing reasons, claim 1 and claims 2-4 and 7-11, which are dependent on claim 1, are patentable over the cited art.

If, for any reason, the examiner is unable to allow the application in the next official action, the examiner is encouraged to telephone the undersigned agent at the telephone number listed below.

U.S. Serial No. 10/712,740
Response Dated December 23, 2005
Response to the Office action of July 26, 2005

Respectfully submitted,

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A handwritten signature in black ink, appearing to read "m w Zimmerman". The signature is fluid and cursive, with a horizontal line extending to the right from the end of the "m".

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Agent for Applicant

Dated: December 23, 2005